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US 4527092 A

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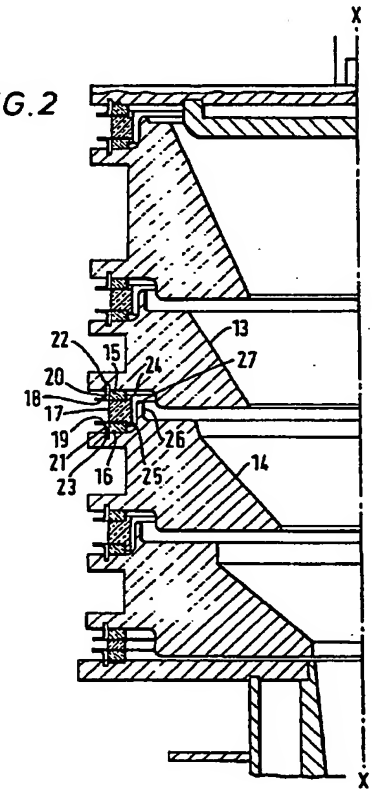
(54) Electron beam tubes

(57) In an electron beam tube such as a klystron, a vacuum seal comprises a ceramic cylindrical wall 17 on which are brazed metal rings 18 and 19 which are welded to flares 20 and 21 fixed to electrodes 13 and 14 of a collector. Ceramic rings 15 and 16 are located between the metal rings 18 and 19 and the electrodes 13 and 14. The wall 17 includes inner flanges 24 and 25 which overlap the inner peripheries of the rings 18 and 19 hence reducing the likelihood of arcing occurring between them and other parts of the arrangement at different potentials.

FIG.2



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

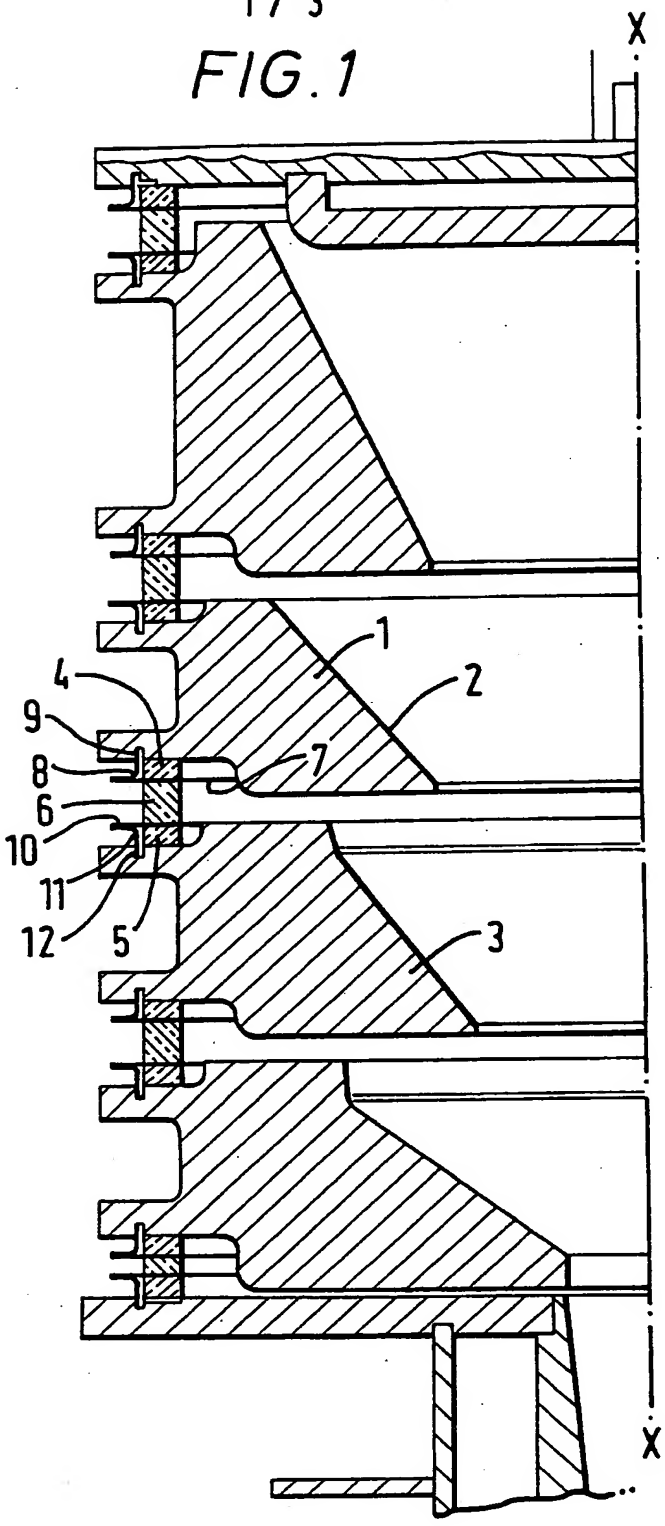


FIG.2

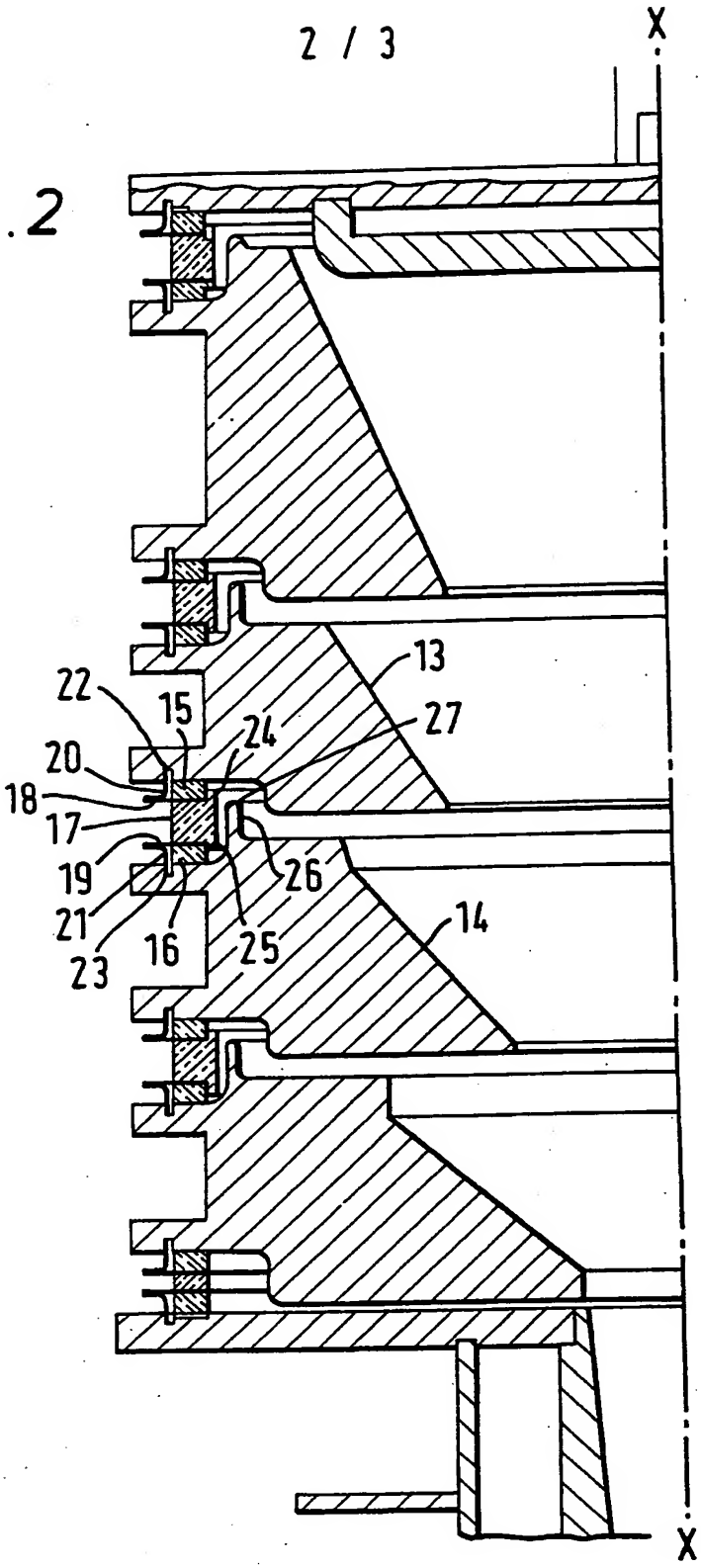


FIG. 2a

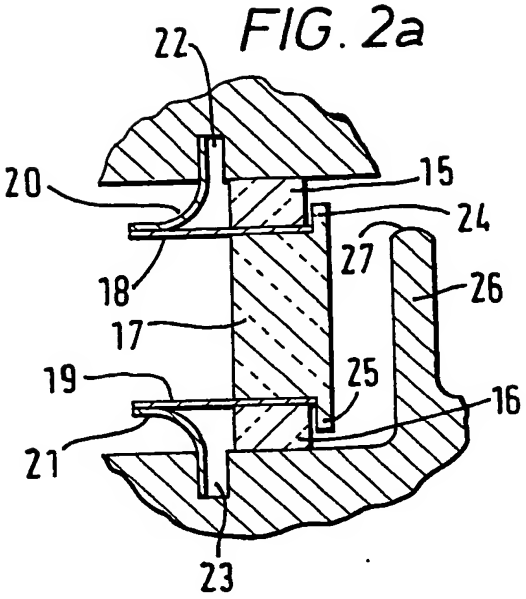
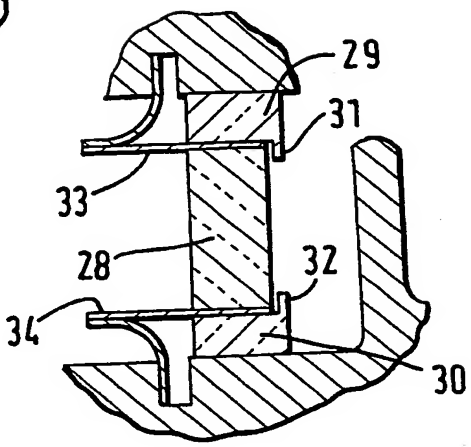


FIG. 3



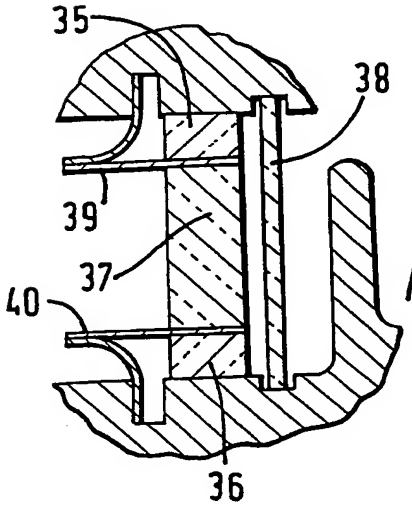


FIG. 4

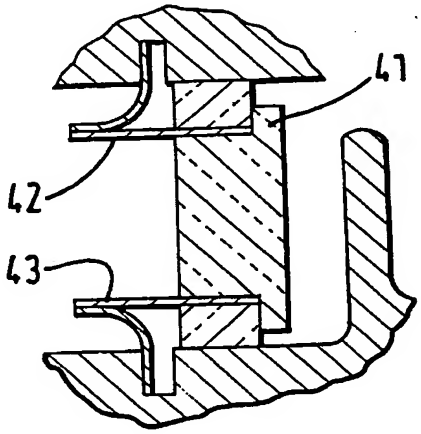


FIG. 5

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Electron Beam Tubes

This invention relates to electron beam tubes and more particularly, but not exclusively, to the construction of collectors employed in klystrons and other linear beam tubes.

In one type of collector used in klystrons and other linear beam tubes, such as travelling wave tubes, a plurality of annular electrodes are disposed along the length of the collector. Adjacent electrodes are maintained at different potentials to reduce the impact energy of the electrons at the electrode surfaces, thus providing an energy saving collector.

The interior of the collector is maintained at near high vacuum. The vacuum envelope includes cylindrical ceramic walls which extend between adjacent electrodes and permit gas tight seals to be made with them. The dimensions of the ceramic walls and the electrodes of the collector are chosen so as to reduce the possibility of arcing. If arcing occurs it may cause failure of the electrical insulation between collector electrodes which will lead to interruption of the operation, or even the destruction, of the tube.

Part of a collector of known construction is illustrated schematically in Figure 1 which is a longitudinal section showing half of the cylindrical structure which is symmetrical about the longitudinal axis X-X. A cylindrical electrode 1 of the collector includes a radially inwardly directed portion 2 arranged to intercept electrons of the

beam as they travel in the longitudinal direction, being deflected by the electrical potentials on the electrodes. A second generally cylindrical electrode 3 is located adjacent the first electrode 1 and spaced apart from it in the axial direction. Two ceramic rings 4 and 5 are located adjacent transverse surfaces of the electrodes 1 and 3 respectively. A cylindrical ceramic wall 6 is extensive between the rings 4 and 5 and is of similar radial thickness to them. A metal ring 7 is positioned between one of the ceramic rings 4 and an end face of the wall 6 to which it is brazed, the inner diameter of the ring 7 being substantially the same as that of the wall 6 and rings 4 and 5. A metal flare 8 is brazed in an annular slot 9 in the electrode 1 and includes a transverse portion which is welded to the outer periphery of the ring 7 to make a gas tight seal around its circumference. A second metal ring 10 is located between the wall 6 and second ceramic ring 5 and is welded to another flare 11 which is also brazed in a slot 12 in the electrode 3. A vacuum seal is thus obtained between the electrodes 1 and 3.

The rings 4 and 5 press against the metal rings 7 and 10, taking the axial thrust due to external pressure when the tube is under vacuum. In addition, they form a sliding abutment with the transverse surfaces of the electrodes 1 and 3 to accommodate for differential thermal expansion between the cylindrical wall 6 and the electrodes 1 and 3.

The present invention seeks to provide an improved collector assembly but may also be applied to other parts of an electron beam tube where a gas tight seal is required and where high voltages are present between adjacent metallic components.

According to the invention, there is provided an electron beam tube comprising a ceramic cylindrical wall forming part of a vacuum envelope, a ceramic ring and a metal ring located between them, ceramic material being located radially inwardly of the metal ring and being extensive through the transverse plane in which its inner periphery is located so as to shield it.

The ceramic material shields the edge of the metal ring and hence, by employing the invention, the likelihood of arcing between it and other parts within the tube at different electrical potentials may be substantially reduced. This leads to an improvement in the operation of the tube and also permits greater freedom in choice of its geometry. The invention is particularly advantageously applied to a collector arrangement in which electrodes of the collector operate at different potentials. The electrode potentials may differ by some tens of kilovolts. The difference in voltages may be considered large if, in the absence of the ceramic material, there is a significantly increased probability that arcing would occur between them. This is dependent on the spacings between parts at different voltages and their shapes. Part of one of the electrodes may be arranged to be co-extensive with, and radially inward of, the ceramic wall to shield it from electron bombardment which might otherwise cause damage. The ceramic material interposed between the metal ring and the extension to the electrode prevents electrical breakdown between the shielding part of the electrode and the metal ring.

The metal ring may be mounted on an end face of the wall, this arrangement being advantageous where it forms part of a collector.

In a preferred embodiment of the invention, the ceramic material shielding the ring is part of the cylindrical wall. Where two ceramic rings and metal rings are included in the arrangement, being located at each end of the cylindrical wall, then only one component of the assembly need be machined to a more complicated shape to implement the invention.

In another arrangement in accordance with the invention, the ceramic material is part of the ceramic ring. In the type of arrangement which requires two ceramic rings it is necessary to fabricate two parts of the assembly with a more complicated configuration. However, if the cylindrical wall is of relatively long axial extent, this may be a desirable arrangement to reduce the amount of ceramic material needed.

In another embodiment in accordance with the invention, the ceramic material consists of tube member located co-axially within the wall. This arrangement has the advantage that each of the ceramic components of the assembly may be a simple cylinder requiring no stepped portions.

The shielding ceramic material may abut the inner periphery of the metal ring or be spaced some distance from it. More effective shielding may be produced if the ceramic material is in direct contact with the metal ring around its inner circumference and this configuration may also be useful for accurate location of components during assembly of the tube.

The invention may be advantageously applied to parts of electron beam tubes

other than collectors. For example, in external cavity klystrons, it is necessary to have a vacuum tight seal in a region of a cavity where high voltage hold-off is required and the ceramic material for shielding may be included.

Some ways in which the invention may be performed are now described by way of example with reference to the accompanying drawings in which:

Figure 2 schematically illustrates part of an electron beam tube in accordance with the invention;

Figure 2A is an enlarged view of part of Figure 2; and

Figures 3, and 4 schematically show respective different arrangements in accordance with the invention.

With reference to Figures 2 and 2A, a multi-stage collector of a klystron or other electron beam tube includes two annular electrodes 13 and 14 shown in longitudinal section, only half the arrangement being illustrated. Two ceramic rings 15 and 16 and a cylindrical ceramic wall 17 are located between the electrodes 13 and 14. Annular metal rings 18 and 19 are positioned between end faces of the wall 17 and the rings 15 and 16 respectively. The metal rings 18 and 19 are brazed to metallised end faces of the wall 17 and are welded to respective cylindrical flares 20 and 21. The flares 20 and 21 are located in annular grooves 22 and 23 in the electrodes 13 and 14 and are brazed in position to give a gas tight seal.

The ceramic wall 17 is of greater radial thickness than the balance rings 15 and 16, having a smaller internal diameter The radially innermost part of the wall 17 is of greater extent in the longitudinal axial direction having inner flanges 24 and 25 extending substantially parallel to the axis X-X. The flanges 24 and 25 are of sufficient axial extent that they extend through the plane in which the rings 18 and 19 lie and are closely spaced from them in a radial direction.

One of the electrodes 14 includes a cylindrical flange 26 which is substantially co-extensive with the inner surface of the wall 17. This protects the ceramic from electron bombardment, arcing between the end 27 of the flange and the ring 18 electrically connected to the adjacent electrode 13 being prevented by the interposed ceramic material of the flange 24 of the wall 17.

Figure 3 schematically illustrates part of another embodiment of the invention which is similar to that shown in Figure 2a. However, in this embodiment, the cylindrical wall 28 is of uniform radial thickness along its axial length and the ceramic rings 29 and 30 include projecting flanges 31 and 32 respectively to provide shielding of the inner edge of the metal rings 33 and 34.

With reference to Figure 4, another arrangement in accordance with the invention includes two ceramic rings 35 and 36 and a cylindrical wall 37, each of the components being of substantially the same radial thickness. A thin ceramic tube 38 is located co-axially within the wall 37 to provide shielding of the metal ring 39 and 40.

Figure 5 schematically shows an assembly similar to that of Figure 2a, but in this embodiment, the ceramic material 41 shielding the inner face of the metal rings 42 and 43 is in contact with them.

In the illustrated embodiments of the invention, the ceramic wall is longer in the axial direction than the ceramic ring or rings. In other arrangements the ceramic ring, or rings, may be of substantially the same axial length as the ceramic wall or may be longer than it.

CLAIMS

1. An electron beam tube comprising a ceramic cylindrical wall forming part of a vacuum envelope, a ceramic ring and a metal ring located between them, ceramic material being located radially inwardly of the metal ring and being extensive through the transverse plane in which its inner periphery is located so as to shield it.

2. A tube as claimed in claim 1 wherein the metal ring is mounted on an end face of the wall.

3. A tube as claimed in claim 1 or 2 wherein the ceramic material is part of the cylindrical wall.

4. A tube as claimed in claim 3 wherein the cylindrical wall includes an inner axially extensive flange, the inner circumferential surface of the wall being of greater longitudinal axial extent than its outer circumferential surface.

5. A tube as claimed in claim 1 or 2 wherein the ceramic material is part of the ceramic ring.

6. A tube as claimed in claim 1 or 2 wherein the ceramic material consists of a tube member located co-axially within the wall.

7. A tube as claimed in any preceding claim wherein the ceramic material abuts the

inner periphery of the metal ring.

8. A tube as claimed in any preceding claim and including an electrically conductive member located within the vacuum envelope, the ceramic material being located between the member and the metal ring and, during use, the member being maintained at a potential sufficiently different from that of the metal ring that in the absence of the ceramic material arcing would occur between them.

9. A tube as claimed in any preceding claim and including a second ceramic ring and a second metal ring located between the wall and the second ceramic ring, with additional ceramic material being located radially inwardly of the second metal ring and being extensive through the transverse plane in which its inner periphery is located so as to shield it.

10. A tube as claimed in claim 9 wherein the additional ceramic material is contiguous with the first mentioned ceramic material.

11. A tube as claimed in claim 9 or 10 wherein, in operation, the first and second metal rings are maintained at substantially different electrical potentials.

12. A tube as claimed in claim 9, 10 or 11 wherein the second metal ring is mounted on an end face of the ceramic wall.

13. A tube as claimed in any preceding claim wherein the or each metal ring is sealed

to a respective cylindrical flare to define part of the vacuum envelope.

14. A tube as claimed in any preceding claim wherein the cylindrical wall forms part of a multi-stage collector arrangement.

15. An electron beam tube substantially as illustrated in and described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

-11-

Application number
GB 9409926.4

Relevant Technical Fields

(i) UK Cl (Ed.M) H1D (DK)

(ii) Int Cl (Ed.5) H01J

Search Examiner
G M PITCHMAN

Date of completion of Search
14 JULY 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI, CLAIMS

Documents considered relevant following a search in respect of Claims :-
1-15

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	US 4527092 (EBIHARA) See Figure 1	1

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).